

# Preliminary

## Transmission Loss Study - Duchesne and Strawberry Rivers 1971 - 1972

Of the water diverted for irrigation in the Duchesne River Basin some is lost before being applied for irrigation. This loss consists of seepage through the bottoms and banks of canals, evapo-transpiration by the growth along each canal, and leakage through canal banks and the bottoms of canals through rocks not sealed by fine material. The water lost while being transported in canals to the place of use is perhaps the most significant. This seepage is lost to appropriation by the water user in the canal, but it is believed that some of it returns to the river and is diverted by water users further downstream.

During 1971 and 1972 Donald C. Norseth and Robert F. Guy of the Division of Water Rights and Loryn Ross, Duchesne-Strawberry Water Commissioner, measured losses in selected canals and ditches diverting from the Duchesne and Strawberry Rivers. These measurements were taken in selected reaches of the canals. The chosen reaches take advantage of measuring devices already installed, have a minimum of turnouts, and provide for measurement of all inflow to the canals. These canals were selected taking into account the geographic location, the soils, the shape, and the capacities that represented different areas with associated problems.

It is fully recognized that canal losses vary and are influenced by many parameters that cannot be accurately determined or easily measured. However, the assumption was made that field measurement under actual conditions of selected reaches would be sufficiently accurate for purposes of estimating diversion needs for water allowance.

The inflow-outflow method of determining seepage was selected, wherein water accruing to each reach was measured, all water diverted from the canal was measured or all turnouts closed, and all water leaving the reach was

measured with the loss calculated between the points of measurement determined. Most canals are wide, flat, and shallow and have numerous turnouts scattered along the canal generally starting close to the river diversion. Difficulty was experienced in selection of reaches to measure flow difference that could be related to each canal, and measurements generally represent maximum losses.

Canals selected for this study and checked in the field during the 1971 and 1972 irrigation seasons showed losses varying from 61% to small gains.

The canals selected for measurement during the 1971 and 1972 irrigation seasons were: Rhoades Canal, Pioneer Canal, Rocky Point Canal, and Grey Mountain Canal from the Duchesne River and Raleigh-Ivie (Peterson) Canal from the Strawberry River. In addition to measuring these canals, check measurements were made on Big Springs, Pahcease, Broadhead, and Pender #2 Ditches.

#### Rhoades Canal

The Rhoades Canal heads in Section 7, T1N, R8W, USB&M, about four miles northeast of Hanna, Utah, and trends in a southeasterly direction approximately nine miles across an area of glacial deposits, landslide detritus, and alluvial material. It diverts from the North Fork of the Duchesne River and traverses approximately 1.5 miles to a confluence with Big Springs. The section of the canal selected for study is a 1.5 mile reach heading about five hundred feet below the confluence with Big Springs to the present place of measurement near the Forest Service pasture. There are two six-foot parshall flumes at the top and bottom of this reach.

The upper portion of the canal is floored with cobbles with very little fine material. The canal undergoes a change between the lower parshall flume and the Cox divider, and the bottom of the canal is coated with a fine

silty sand. It is anticipated that the seepage from this point down would be less than the section selected.

The average flow during the period of measurement was 29.22 second-feet with an estimated loss of 7% per mile for the entire canal.

#### Pioneer Canal

The Pioneer Canal heads in Section 29, T2S, R5W, USB&M, and traverses in a southeasterly direction across alluvial material approximately 5.5 miles. From the diversion in Section 29, turnouts are in evidence along the length of the canal with accretion to the canal from irrigation on the lands immediately above. A 1.2 mile reach of the canal was selected near the Brady Ranch in Section 35, T2S, R5W, USB&M. There is a two-foot parshall flume at the top and a two-foot parshall flume at the bottom of the reach. The canal is overgrown with brush and has a silty sandy bottom. Some measurements show a gain in the upper section. Water was visibly observed running into the canal. The average flow during the period of measurement was 9.6 second-feet. The estimated transmission loss for the entire canal was 7.37 % per mile.

#### Rocky Point Canal

The Rocky Point Canal heads in Section 12, T3S, R5W, USB&M, and traverses southerly along the river bottom, then easterly along a rocky, gravelly hillside approximately 5.1 miles to a split in the canal. The upper branch traverses northeasterly approximately eight miles while the lower branch traverses southeasterly approximately five miles. A 3.6-mile reach was set up from the canal heading to the bridge above the main road into Duchesne. It was not possible to select a reach from which the adequate measurements could be obtained. Under agreement with the United States Geological Survey, they conducted a study of the seepage

losses of this canal. Their preliminary figures showed an estimated loss of ~~0.33%~~<sup>1.87%</sup> per mile for 17.90 miles of canal.

#### Grey Mountain Canal

The Grey Mountain Canal heads in Section 1, T4S, R4W, USB&M, and traverses easterly approximately 6.6 miles to a split in the canal where the Grey Mountain Canal traverses in a northeasterly direction approximately 6.3 miles. The Taylor (Pleasant Valley) Canal branches off and traverses southeasterly approximately 16 miles. It is noted that there was not a good reach in this area where a good seepage-loss study could be conducted due to many turnouts starting below the diversion, and the canal was too large to enable the making of significant spot measurements. Under agreement with the United States Geological Survey, they conducted a study of the seepage losses from this canal. Their preliminary figures show an estimated loss of 0.37% per mile for approximately 28.9 miles of canal.

#### Raleigh-Ivie (Peterson) Canal

The Raleigh-Ivie Canal was selected to represent the ditches from the Strawberry River. It is felt that this ditch is typical of many small ditches diverting from this source. The ditch heads in Section 7, T4S, R6W, USB&M, and traverses in a northeasterly direction 1.2 miles across the alluvial Strawberry Valley. A reach with a three-foot penvane section at the top was selected. A three-foot penvane section was installed at the bottom in 1971. This provided a short measured reach of 0.4 mile. In 1972 the lower penvane box was moved downstream. However, the measurements were too erratic to provide a reliable seepage loss due to water users opening turnouts and seepage through turnouts. However, for the purposes of this report, the 1971 measurements will be utilized. These measurements were

taken from the top pervane box downstream to the pervane box installed near the Castle Creek culvert. The estimated loss per mile was approximately 21.8% in this reach. The average flow of the ditch was 4.77 second-feet for the period of measurement.

In addition to the above-selected canals, the following seepage loss measurements were made:

Table I  
(data observed in the field)

<u>Ditch</u>	<u>Flow in Reach (c.f.s.)</u>		<u>Length of Reach</u> <u>miles</u>	<u>Loss per Mile</u> <u>%</u>
	<u>Top</u>	<u>Bottom</u>		
Big Springs	6.26	2.41	2.18	28.0
Broadhead	5.25	4.25	1.28	5.3
Pahcease	5.53	5.28	0.47	9.5
Pender #2	3.50	2.90	1.67	30.1

A check of past diversion records of the canals under study, with the exception of the Raleigh-Ivie Canal on which no daily diversion records are available, shows that each canal has diverted about 60% of its water in the months of May, June, and July. See Chart 1. Small amounts have been diverted in April and October. Chart 2 gives the relationship between the water diverted and the water available for irrigation by percentage and the percentage of loss per mile of canal. Chart 3 gives the headgate versus farm delivery relationship with the relationship to the average diversion and delivery for the period 1961-1970 as indicated by the measurements of these canals during the irrigation seasons of 1971 and 1972.

Chart 1

Water Utilization per Month in Percentage of Annual Diversion  
1961 - 1970

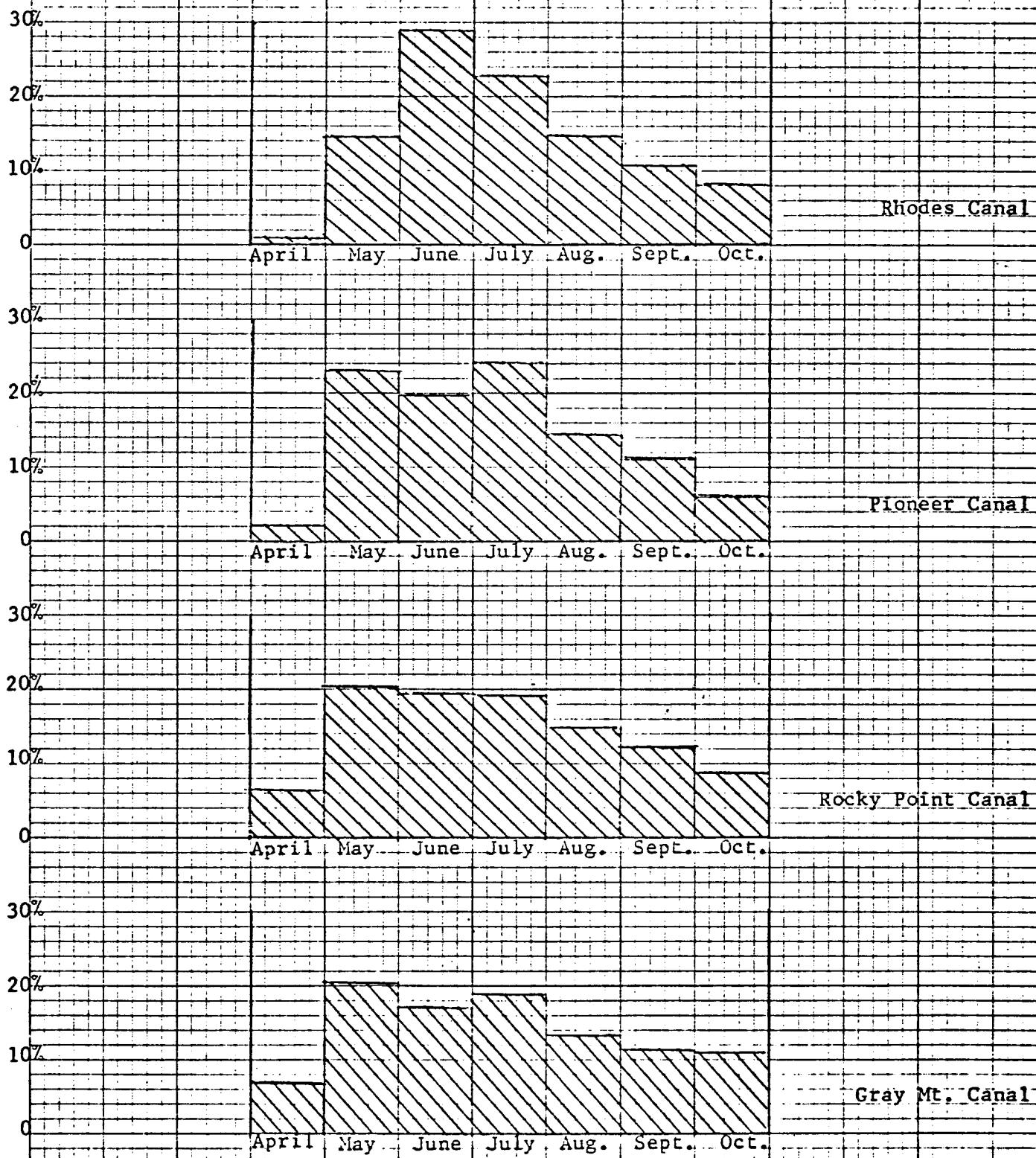


Chart 2  
Diversions - Farm Delivery in Percentage

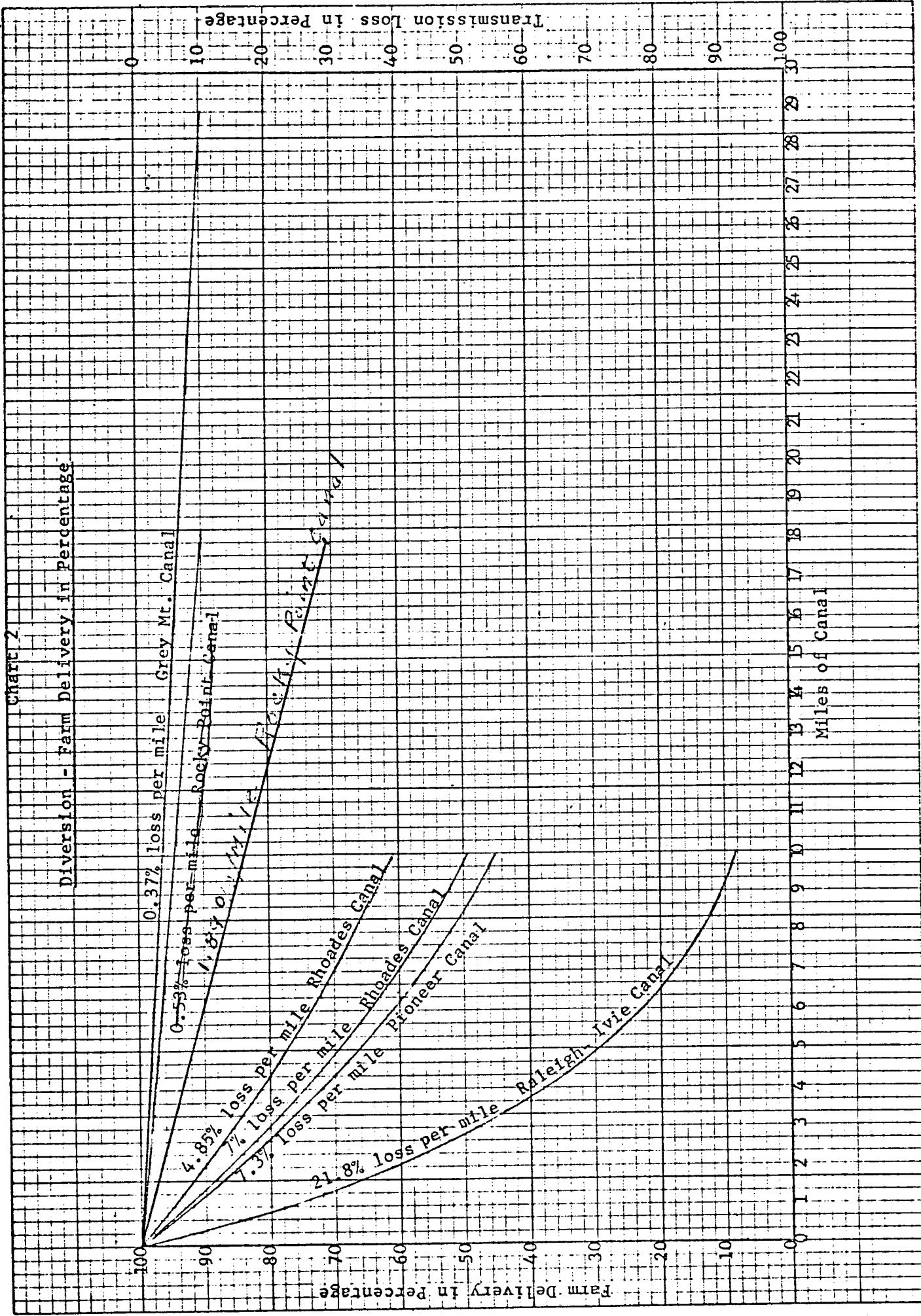


Chart 3

Diversions Chart  
Headgate Requirement

Canal	Water Right <sup>1/</sup>			Diversions <sup>2/</sup>			Requirement <sup>6/</sup>			
	Flow	Irr.	Land	Canal Length	Projected <sup>4/</sup> Delivery	Aver. Diversion <sup>4/</sup> 1961-1970	Field Delivery	per acre	per acre	Diversion <sup>6/</sup> (headgate delivery)
	c.f.s.	acres	miles	ac.-ft.	ac.-ft.	ac.-ft.	ac.-ft.	ac.-ft.	ac.-ft.	ac.-ft.
Rhoades	22.74	1,058.60	8.98	9,724	8,287	3,935	4,350	3,176	4,234	6,049
	22.74	1,058.60	8.98	9,724	8,287	3,000	5,287	3,176	4,234	4,978 <sup>7/</sup>
Pioneer	22.78	1,427.31	5.59	9,749	5,802	2,130	3,672	4,282	5,709	6,765
Rocky Point	46.16	3,539.70	17.9	19,756	13,204	3,538	9,366	10,619	14,159	14,971 <sup>8/</sup>
	249.45	16,312.07	28.9	106,765	68,575	7,338	61,237	48,936	65,248	54,800
Raleigh-Ivie	6.0	360	1.2	2,528	---	---	---	1,080	1,440	1,444

<sup>1/</sup>All figures from priority schedule.<sup>2/</sup>Based on average diversion 1961-1970 for 214-day irrigation period.<sup>3/</sup>Based on 100% delivery for full flow rights.<sup>4/</sup>Commissioners' reports analysis.<sup>5/</sup>Calculated from acreage (acres x 3) (acres x 4).<sup>6/</sup>Headgate requirement for 3 ac.-ft. per acre farm delivery based on transmission loss study.<sup>7/</sup>Computed from canal run. Needs additional check.

Summary of Annual Records from Commissioner's Reports  
1961 - 1970

Canal	Year	Irr. Period Start	Period End	Total Diversion (ac.-ft.)	Acres	Ac.-ft. per Acre (ac.-ft.)
Rhoades	1970	5/15	10/31	7,222	1,001	7.215
	1969	5/14	10/31	9,089	899	10.110
	1968	5/18	10/31	9,396	899	10.452
	1967	5/21	10/31	8,199	899	9.120
	1966	5/11	10/31	6,828	899	7.595
	1965	5/21	10/31	10,001	899	11.125
	1964	5/21	10/31	8,159	899	9.075
	1963	5/16	10/22	6,759	899	7.518
	1962	5/7	10/31	11,283	899	12.551
	1961	4/20	10/26	5,939	933	6.365
Pioneer	1970	5/1	10/31	6,436	1,290	4.989
	1969	5/1	10/31	6,260	1,290	4,853
	1968	5/6	10/31	6,647	1,401	4,744
	1967	4/20	10/31	6,583	1,401	4,699
	1966	4/26	10/20	5,511	1,217	4,528
	1965	5/5	9/16	4,579	1,217	3.762
	1964	5/2	10/31	6,027	1,217	4.952
	1963	4/15	10/19	5,607	1,302	4.306
	1962	4/27	10/2	6,350	1,302	4.877
	1961	4/14	10/31	4,022	1,320	3.047
Rocky Point	1970	3/25	10/31	15,135	2,752	5.499
	1969	4/18	10/31	15,558	2,752	5.653
	1968	4/13	10/31	14,684	2,748	5.344
	1967	4/21	10/31	15,536	2,748	5.654
	1966	4/18	10/20	14,129	2,748	5.142
	1965	4/20	10/21	10,455	2,435	4.294
	1964	4/22	10/16	11,685	2,435	4.799
	1963	4/1	10/31	12,700	2,435	5.216
	1962	4/19	10/31	12,803	2,435	5.258
	1961	4/1	10/16	9,356	2,435	3.841
Grey Mt.	1970	3/24	10/31	72,311	13,875	4.965
	1969	4/18	10/31	74,666	13,875	5.575
	1968	4/3	10/31	83,364	13,875	5.799
	1967	4/17	10/31	77,505	13,875	5.399
	1966	4/9	10/31	71,904	13,680	5.387
	1965	4/20	10/31	58,508	13,167	4.417
	1964	4/3	10/31	66,587	13,432	5.107
	1963	4/1	10/31	66,574	13,452	5.470
	1962	4/28	10/31	68,286	14,092	4.876
	1961	3/20	10/31	46,050	13,113	3.370

Length of Diversion Period  
1961 - 1970

Year	Canals			
	Rhoades	Pioneer	Rocky Point	Grey Mt.
	days	days	days	days
1961	190	191	196	226
1962	178	159	196	187
1963	157	159	214	214
1964	164	183	177	211
1965	163	133	176	182
1966	174	173	186	206
1967	164	188	190	198
1968	167	179	198	209
1969	171	155	197	195
1970	170	184	221	217
Average	170	170	195	205

Maximum            217 - Grey Mountain Canal  
 Minimum          133 - Pioneer Canal

Duchesne Diversions  
1961 - 1970

Year	April		May		June		July		August		September		October		Annual ac-ft		
	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	c.f.s.	ac.-ft.	
<u>Rhoades Canal</u>																	
1961	160	316	936	1,856	829	1,644	215	425	280	554	418	828	159	316	5,939		
1962			1,094	2,169	1,653	3,274	1,434	2,844	760	1,507	403	799	346	686	11,283		
1963			619	1,227	926	1,837	663	1,315	488	968	365	724	347	688	6,759		
1964			340	674	1,487	2,949	1,308	2,593	441	875	275	545	264	523	8,159		
1965			337	609	1,379	2,737	1,259	2,497	1,041	2,064	595	1,100	462	916	10,001		
1966			843	1,672	1,189	2,358	510	1,011	400	793	315	625	186	369	6,828		
1967			334	662	1,110	2,215	1,078	2,138	922	1,828	852	1,690	435	853	9,395		
1968			358	710	1,027	2,037	1,317	2,612	610	1,210	409	811	413	819	8,199		
1969			806	1,598	1,261	2,501	830	1,646	565	1,160	434	861	535	1,061	9,089		
1970			470	932	1,167	2,314	960	1,908	552	1,095	412	817	211	418	7,227		
Total	160	316	6,137	12,109	13,028	23,866	9,576	18,989	6,059	12,054	4,478	8,800	3,358	6,649	82,874		
Average	16.0	31.6	613.7	1,210.9	1,302.8	2,386.6	957.6	1,898.9	605.9	1,205.4	447.8	880.0	335.8	664.9	8,287.4		
Daily Average	14.6	29	19.8	39.7	40.1	795.5	30.9	61.3	19.5	38.9	14.9	29.3	10.8	21.4			
% of Average																	
Annual Diversion			0.38		14.61		28.8		22.91		14.54		10.62		8.02		
<u>Pioneer Canal</u>																	
1961		101	199	550	1,090	482	955	286	567	293	582	177	352	140	277	4,022	
1962		49	98	768	1,523	674	1,336	816	1,618	459	911	409	811	27	53	6,350	
1963		193	382	674	1,336	680	1,348	626	1,242	419	830	7	14	230	455	5,607	
1964				588	1,186	554	1,098	769	1,542	437	866	318	631	374	742	6,027	
1965				412	817	578	1,146	733	1,454	304	603	282	559			4,579	
1966		142	282	659	1,207	782	1,551	484	960	380	754	292	479	140	278	5,511	
1967		104	206	823	1,637	344	682	795	1,576	566	1,122	485	962	203	403	6,583	
1968				571	1,132	707	1,407	872	1,729	348	690	605	1,200	249	494	6,647	
1969				863	1,711	378	750	826	1,638	519	1,029	423	839	148	293	6,260	
1970				713	1,414	605	1,200	812	1,610	444	880	386	765	286	567	6,436	
Total	589	1,167	6,621	13,053	5,784	11,473	7,019	13,936	4,169	8,267	3,384	6,612	1,797	3,562	58,022		
Average	58.9	116.7	662.1	1,305.3	578.4	1,147.3	701.9	1,393.6	416.9	826.7	338.4	661.2	179.7	356.2	5,802.2		
Daily Average	19.6	38.9	21.4	42.1	19.3	38.2	22.6	45.0	13.4	26.7	11.3	22.0	5.8	11.5			
% of Average																	
Annual Diversion			2.0			22.5		19.8		24.0					11.4	6.1	

Duchesne Diversions  
1961 - 1970